HTIR-TC: Providing accurate measurement in high-temperature and neutron radiation environments

Today, many manufacturing and operating processes for producing electricity, refining chemicals, and fabricating steel, glass and ceramics – and much more – require temperatures between 1,100°C and 1,700°C.

Safe, efficient and economical operations need accurate and reliable measurements.

Unfortunately, too often existing thermocouple measuring devices experience decalibration or outright failure, requiring companies to use various work-around methods. These are costly, wasteful and not as safe.

Researchers at the Idaho National Laboratory have invented the High Temperature Irradiation Resistant Thermocouple, which offers a breakthrough in measuring high temperature processes.

“We have tested HTIR-TC in our tube furnace at 1,200°C and 1400°C for 4,000 hours. They drifted by less than 2% during the entire 4,000-hour test,” said INL nuclear engineer Joy Rempe, Ph.D. “Type N and type K thermocouples that were tested at the 1,200°C test drifted within 2% within the first 200 hours. In the 4,000 hours they were tested, they drifted by over 100°C. Clearly, HTIR-TC is an improvement in high temperature thermometry.”

INL’s research team applied its experience with design, metallurgy and high temperature testing to develop the unique and superior HTIR-TC. After lengthy experimentation, they have combined the right metals and insulation with superior, proprietary junction and fabrication methods.

HTIR-TC delivers high temperature accuracy about 20 times longer than existing technologies. The results are:

- Safer processes;
- More efficient process control;
- Reduced maintenance costs;
- Reduced waste; and
- Improved product quality.

Several potential customers in commercial industries reliant upon high temperature processes have expressed interest in HTIR-TC. The first nonreactor application was with a Department of Defense manufacturing customer.

Originally developed for use in nuclear test reactors, HTIR-TC may enhance the safety of operations in future reactors.

“We have found that high temperature thermocouples are an important element for controlling our laboratory high temperature processes, such as this tube furnace for an extended period of time,” said INL mechanical engineer Keith Condie. “More applications are being identified for HTIR-TC, including semiconductor manufacturing, superalloy processes, gas furnace flame ignition safety, laboratory instrumentation, coating processes, and refractory metal fabrication, to list just a few.”

“The tests have proven the HTIR-TC to be stable, durable and reliable at high temperatures, potentially up to 2,000°C,” said INL nuclear engineer Darrell Knudson. “We believe it to be resistant to irradiation, reasonably priced, and easy to install.”

Because 21st century living will continue to rely upon high temperature processes, the HTIR-TC breakthrough will ensure:

- Safer high-temperature manufacturing processes;
- Efficient use of energy; and
- Better process control.